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Experimental manifestations of the Nb4+-O- polaronic excitons in KTa0.988Nb0.012O3

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Abstract

The formation of the photopolaronic excitons in ABO3 perovskite-type oxides has been detected experimentally by means of the photoinduced electron paramagnetic resonance (EPR) studies of KTa 0.988Nb0.012O3 crystals. The corresponding microwave x-band spectrum at T< 10 K consists of a narrow, nearly isotropic signal located at g ~ 2 and a strongly anisotropic component. The first signal, which has a rich structure due to hyperfine interactions with the lattice nuclei, is attributed to the single trapped charge carriers: the electrons and/or the holes. The anisotropic spectrum is caused by the axial centers oriented along the C4 pseudocubic principal crystalline axes. The spectrum angular dependence can be described well by an axial center with S = 1, g = 0.82, g = 0.52, and D = 0.44 cm-1. The anisotropic spectrum is attributed to the Nb4+-O- polaronic excitons. The temperature dependence of the anisotropic component is characterized by two activation energies: the internal dynamics activation Ea1 = 3.7 ± 0.5 meV, which makes the EPR spectrum unobservable above 10K, and the destruction energy Ea2 = 52 ± 4 meV. By comparing the anisotropic photo-EPR spectrum and the photoinduced optical absorption temperature dependencies, we found that the Nb4+-O - polaronic excitons also manifested themselves via the wide absorption band at ~0.7 eV arising under ultraviolet light excitation in the weakly concentrated KTaO3:Nb crystals. © 2011 American Physical Society.

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